

Claims:

What is claim is:

1. A high brightness light emitting diode (LED) emitting light of white or desire color, comprising:
  - a substrate;
  - an epitaxial layer comprising a first-type cladding layer disposed on said substrate,
  - a first active layer emitting light of first wavelength and disposing on said first-type cladding layer, a second active layer emitting light of second wavelength,
  - and a second-type cladding layer;
  - a first electrode disposed on an exposed portion of said first-type cladding layer;
  - a second electrode disposed on said second-type cladding layer.
2. The high brightness light emitting diode (LED) of claim 1, further comprises a transition active layer sandwiched between said first and said second active layers.
3. The high brightness light emitting diode (LED) of claim 2, wherein a material system of said transition active layer is selected from a group comprising  $(\text{Al}_{0.5}\text{Ga}_{0.5})_{0.5}\text{In}_{0.5}\text{P}_{0.5}\text{N}_{0.5}$  ( $0 < x \leq 1$ ,  $0 < y \leq 1$ ,  $0 < z \leq 1$ ).
4. The high brightness light emitting diode (LED) of claim 1, further comprises a buffer layer sandwiched between said substrate and said first-type cladding layer.
5. The high brightness light emitting diode (LED) of claim 1, further comprises a current spreading layer sandwiched between said second electrode and said second-type cladding layer.

6. The high brightness light emitting diode (LED) of claim 1, wherein a material system of said first active layer is selected from a group comprising  
 $(\text{Al}_{0.5}\text{Ga}_{0.5})_{1-x}\text{In}_{0.5}\text{P}_{0.5}\text{N}_{1-z}$  ( $0 < x \leq 1$ ,  $0 < y \leq 1$ ,  $0 \leq z < 1$ ).
7. The high brightness light emitting diode (LED) of claim 1, wherein a material system of said second active layer is selected from a group comprising  
 $(\text{Al}_{0.5}\text{Ga}_{0.5})_{1-x}\text{In}_{0.5}\text{P}_{0.5}\text{N}_{1-z}$  ( $0 < x \leq 1$ ,  $0 < y \leq 1$ ,  $0 \leq z < 1$ ).
8. The high brightness light emitting diode (LED) of claim 1, wherein a material system of said first cladding layer is selected from a group comprising  
 $\text{B}_{0.5}\text{Al}_{0.5}\text{Ga}_{0.5}\text{In}_{1-x-y-z}\text{P}_{0.5}\text{N}_{1-u}$  ( $0 < x \leq 1$ ,  $0 \leq y < 1$ ,  $0 \leq z < 1$ ,  $x + y + z \leq 1$ ,  $0 \leq u < 1$ ).
9. The high brightness light emitting diode (LED) of claim 1, wherein a material system of said second cladding layer is selected from a group comprising  
 $\text{B}_{0.5}\text{Al}_{0.5}\text{Ga}_{0.5}\text{In}_{1-x-y-z}\text{P}_{0.5}\text{N}_{1-u}$  ( $0 < x \leq 1$ ,  $0 \leq y < 1$ ,  $0 \leq z < 1$ ,  $x + y + z \leq 1$ ,  $0 \leq u \leq 1$ ).
10. A high brightness light emitting diode (LED) emitting light of white or desire color, comprising:  
 a submount;  
 an epitaxial layer comprising a first-type cladding layer, a first active layer emitting light of first wavelength, a second active layer emitting light of second wavelength, a second-type cladding layer disposed on one side of said submount;  
 a first electrode disposed on said first-type cladding layer.
11. The high brightness light emitting diode (LED) of claim 10, further comprises a transition active layer sandwiched between said first and said second active layers.

12. The high brightness light emitting diode (LED) of claim 11, wherein a material system of said transition active layer is selected from a group comprising  $(\text{Al}_{0.5}\text{Ga}_{0.5})_{1-x}\text{In}_{0.5}\text{P}_{0.5}\text{N}_{1-z}$  ( $0 < x \leq 1$ ,  $0 < y \leq 1$ ,  $0 < z \leq 1$ ).
13. The high brightness light emitting diode (LED) of claim 10, further comprises a current spreading layer sandwiched between said first electrode and said first-type cladding layer.
14. The high brightness light emitting diode (LED) of claim 10, further comprises a reflector/Ohmic layer sandwiched between said submount and said second-type cladding layer.
15. The high brightness light emitting diode (LED) of claim 14, wherein said reflector/Ohmic layer comprises materials selected from a group comprising metals of Al, Au, Ag, In, Ni, Ti, Pd, Pt, alloys of said metals, and TiN or HfN.
16. The high brightness light emitting diode (LED) of claim 10, wherein a material system of said first active layer is selected from a group comprising  $(\text{Al}_{0.5}\text{Ga}_{0.5})_{1-x}\text{In}_{0.5}\text{P}_{0.5}\text{N}_{1-z}$  ( $0 < x \leq 1$ ,  $0 < y \leq 1$ ,  $0 \leq z < 1$ ).
17. The high brightness light emitting diode (LED) of claim 10, wherein a material system of said second active layer is selected from a group comprising  $(\text{Al}_{0.5}\text{Ga}_{0.5})_{1-x}\text{In}_{0.5}\text{P}_{0.5}\text{N}_{1-z}$  ( $0 < x \leq 1$ ,  $0 < y \leq 1$ ,  $0 < z \leq 1$ ).
18. The high brightness light emitting diode (LED) of claim 10, wherein a material system of said first cladding layer is selected from a group comprising  $\text{B}_{0.5}\text{Al}_{0.5}\text{Ga}_{0.5}\text{In}_{1-x-y-z}\text{P}_{0.5}\text{N}_{1-u}$  ( $0 < x \leq 1$ ,  $0 \leq y < 1$ ,  $0 \leq z < 1$ ,  $x + y + z \leq 1$ ,  $0 \leq u < 1$ ).

19. The high brightness light emitting diode (LED) of claim 10, wherein a material system of said second cladding layer is selected from a group comprising  $B_{0.5-1}Al_{0.5-1}Ga_{0.5-1}In_{0.5-1}P_{0.5-1}N_{0.5-1}$  ( $0 < x \leq 1$ ,  $0 \leq y < 1$ ,  $0 \leq z < 1$ ,  $x + y + z \leq 1$ ,  $0 \leq u \leq 1$ ).
20. The high brightness light emitting diode (LED) of claim 10, wherein said first electrode is patterned for improving current crowding, distributing current more uniformly, increasing current density, and fully utilizing the material of said active layers.
21. The high brightness light emitting diode (LED) of claim 20, wherein said patterned first electrode is a ring-grid-shape.
22. The high brightness light emitting diode (LED) of claim 20, wherein said patterned first electrode is a plus-multi-ring-shape.
23. A LED lam for at least one LED or one LED assembly, comprises:  
 at least one LED or one LED assembly;  
 a base for mounting said LED or said LED assembly;  
 a hemisphere-shaped dome covering said LED or said LED assembly and formed from a material selected from a group comprising epoxy, glass, and plastics;  
 wherein said material being doped with nano-particles so that the refraction index of said material is either the same or similar to that of the material of the top epitaxial layer of said LED or said LED assembly; and wherein the diameter ( R ) of said hemisphere-shaped dome being equal to or larger than the product of said refraction index ( n ) of said material of said dome and the size ( d ) of said LED or said LED assembly,  $R \geq nd$ .

24. The LED lam for at least one LED or one LED assembly of claim 23, further comprises a reflective cup surrounding said dome for reflecting emitted light of said LED or said LED assembly to a desire direction.